

# DESIGN ANALYSIS # 1

**Document Title: Lane Alignment at Southbound Off-Ramp Intersection**

**Project Title: I-5, Northbound On-Ramp at Bakerview – Improvements**

SR5 MP 257.65 TO MP 258.38

XL-5465      PIN-100591R

## WASHINGTON STATE DEPARTMENT OF TRANSPORTATION

Region: Northwest

Office: Bellingham

Prepared by: Albert Goo

Project Engineer: Melissa Ambler



**Document Type :** ☐ Design Decision / ☒ Design Analysis (See Sec. 5 for Approvals)

**Document Phase:** ☐ Preliminary / ☒ Final

Under 23 U.S. Code § 409 and 23 U.S. Code § 148, safety data, reports, surveys, schedules, lists compiled or collected for the purpose of identifying, evaluating, or planning the safety enhancement of potential crash sites, hazardous roadway conditions, or railway-highway crossings are not subject to discovery or admitted into evidence in a Federal or State court proceeding or considered for other purposes in any action for damages arising from any occurrence at a location mentioned or addressed in such reports, surveys, schedules, lists, or data.

## Section 1: Background

### **Briefly describe the project:**

This project constructs a new northbound on-ramp connection from Bakerview Road to I-5 and reconfigures Bakerview Road to optimize for future predicted growth and to accommodate the new on-ramp. See the Basis of Design (BOD) for Details.

### **Provide any background information important to understanding the decision(s):**

Revisions to the channelization of Bakerview Road at the overpass has created the need for the intersection of W. Bakerview Road, W. Maplewood Ave and the existing northbound on-ramp / southbound off-ramp to be reconstructed. The wide existing through lane on the southbound off-ramp was split into two separate lanes in order to accommodate an additional turning movement onto eastbound Bakerview Road.

It should be noted that the 2040 anticipated increase in vehicles travelling from the southbound off-ramp onto eastbound Bakerview road is significantly greater than the volume of traffic traveling in a straight through movement onto Maplewood Avenue.

### **Related documents (such as a Basis of Design):**

- **Interstate 5 / Bakerview Road, Exit 258 Interchange Justification Report (IJR) – Approved June 27, 2017**
- **Basis of Design – PIN 100591R / I-5, Northbound On-Ramp at Bakerview – Improvements – Approved June 1, 2018**

## Section 2: Decision Description

Describe the decision(s) that will be discussed. Identify the design elements that are involved, including the locations. Identify the proposed dimensions and how they compare to Design Manual Guidance.

ID #	Design Element	Location	Guidance	Proposed	Shown on (Sheet #)
IA1	Intersection Angle	A Line	6' Max, 11:1 min taper rate	6.8', 20:1 taper rate	DM 1310.02(3)

### Details

(M1) Design Manual (July 2017) section 1310.02(3), allows for a lane offset of up to 6' at an intersection, and DM Exhibit 1310-1 requires a minimum taper rate of at least 11:1 on roadways with a 25 mph speed limit. Because the existing through lane was 22' wide, the lane was split into a right-turn/through lane and a dedicated left turn lane. This lane split offset the through lane from the center of the receiving lane.

If guidance other than the Design Manual was used describe it here

N/A

## Section 3: Options Evaluation and Decision

Discuss the evaluation methodology. Describe the metrics/considerations that will be used to choose between options. Describe methodology (quantitative or qualitative) and any performance targets. The performance metrics, methods and targets you choose will be part of your performance trade-offs "story"

In order to accommodate anticipated 2040 traffic load, vehicle storage capacity of the turning and through lanes of the SB off-ramp were given a priority. Safety, the cost of rebuilding an intersection, and compatibility with the IJR were also considered in the comparison

Options Comparison Table	Associated Issues (identified in Section 2) *	Metrics / Considerations				
		Storage Capacity	Safety Performance	Operational and Mobility Performance	CN3 – Cost effectiveness / scalability	CN5 – Compatibility with the IJR
<b>Option 1: Two left turn lane option with offset through lane</b>	IA1	+	0	+	+	+
<b>Option 2: Two left turn lane option with rebuilt intersection</b>	IA1	+	0	+	-	+
<b>Option 3: One lane option with left turn integrated into existing through (no build)</b>	IA1	-	0	--	+	-

**Detailed Description of the options evaluated as follows:**

Option 1 – Separating the existing southbound through lane into a left-turn lane onto eastbound Bakerview Road and a through/right turn lane. This option does not change roadway geometry, only channelization, and splits an existing lane into two lanes.

Option 2 – Rebuilding the intersection to accommodate a new turn lane and to better align a new southbound through lane into Maplewood Avenue. This option changes roadway geometry and channelization, and builds out a new turn lane and re-oriens Maplewood.

Option 3 – Re-channelizing the existing southbound through lane into a single hybrid left/right/through lane. This option does not change roadway geometry, only channelization. This option does not add any additional lanes for storage.

**Discuss the performance tradeoffs shown in the table, and compare the performance of the options:**

From the options comparison table above, the introduction of a dedicated left-turn lane improves the storage capacity of the southbound off-ramp and the intersection's operational mobility. The anticipated increase of southbound traffic turning onto eastbound Bakerview in 2040 emphasizes the importance of improving this turning movement and the storage capacity of the ramp.

Conversely, option 2 and option 3 both keep the through/right lane of the off-ramp aligned with Maplewood Avenue, providing a clear path. Option 1's skew (6.8' instead of the 6.0' standard) means that vehicles making a through movement will need to slightly realign their vehicle to match into Maplewood.

**Discuss any mitigating measures added to address performance trade-offs:**

It should be noted that the maximum offset of Option 1 is only 0.8' above the maximum of 6.0' listed in the design manual, and is at almost half the taper rate for the posted speed. This, coupled with the offset being spread out over 5 perpendicular lanes of traffic, makes the scenario presented in Option 1 a more gradual skew than what is accepted in the design manual. Discussion with NWR Traffic have revealed that the safety difference between option 1 and option 2 are negligible. A similar situation exists nearby at the SR 542 and NB Off-Ramp intersection and has had no issues.

Option 1 and Option 2 both create dedicated left turn-lanes on the off-ramp making them operationally identical, but the differential in cost between the two options is significant. Re-orienting Maplewood Ave to match in the newly aligned through lane would require moving the road and all electrical components associated with the intersection as well as additional environmental mitigation, as much of the area adjacent to the Maplewood is heavily wooded. In exchange, option 2's realignment of the receiving road would allow users to drive straight off the off-ramp instead of at a slight skew.

Option 3 converts the existing through/right turn lane of SB I-5 into an left/right/through hybrid lane. This does not increase storage capacity or improve the operational capacity of the intersection, but it does allow vehicles to travel directly into Maplewood Avenue without any skew.

**Preferred Option and reasoning for selecting the preferred option:**

Option 1, which splits the existing wide through lane into a right/through and a dedicated left turn lane, allows for an increase in storage capacity and improvements to mobility at a significantly reduced cost. While the implementation of a skewed receiving lane is sub-optimal, the distance of the skew is marginally higher than what is accepted in the DM, and the length of the intersection reduces the taper rate to a significantly better than what the DM allows. Option 1 helps resolve the issues of the anticipated 2040 traffic loading and thus fully complies with the IJR.

**Evaluation Sheet #\_\_\_\_\_**

*Attach additional evaluations (section 3) as needed to address additional areas*

## Section 4: Attachments

☒ **Vicinity Map**

☐ **Others (list below)**

## Section 5: Approvals

Design Decisions approved by Project Engineer. See WSDOT Design Manual Chapter 300 and required approvals for Design Analysis

**Design Analysis Approvals:** ☒ WSDOT Region / ☒ WSDOT HQ / ☒ FHWA

### Design Decision Approval / Design Analysis Recommended for Approval:

Signed Melissa Ambler  
Print Melissa Ambler  
Date Oct 8, 2020  
Project Engineer

### Design Analysis Approval:

Signed Chris Damitio  
Chris Damitio (Oct 8, 2020 12:25 PDT)  
Print Chris Damitio  
Date Oct 8, 2020  
WSDOT Region

### Design Analysis Approval:

Signed Dean R. Moon  
Print Dean R. Moon  
Date Oct 8, 2020  
WSDOT HQ

### Design Analysis Approval:

Signed Angel D Rivera  
Angel D Rivera (Oct 15, 2020 09:39 PDT)  
Print Angel D Rivera  
Date Oct 15, 2020  
FHWA



# I-5 Northbound On-Ramp at Bakerview Rd - Improvements

## MP 257.65 – MP 258.38

Vicinity Map  
XL5465  
PIN: 100591R



Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

### Legend

	Expressways		FCC		<all other values>		Main Rail Line; Branch line		streets_Signposts
	Highways		Ferry Route		FCC		Edges		
	<all other values>		Major Roads		Ferry Route		SDC Turn Source		
			Minor Roads						

0 430 860 1,720 Feet












# Design Analysis # 1 Lane Alignment at Southbound Off-Ramp Intersection

Final Audit Report


2020-10-15

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